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ENGLISH TRANSLATION OF:

Belgium issued patent:	BE 1010487 (Termed "BE2")
Title	Floor covering consisting of hard floor panels and method for producing said floor panels.
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Note: In Belgium, only a formal examination is being made. No examination is performed on novelty and inventive step. No opposition procedure is available. Only revocation at the court is possible.

Awapatent AB/14 September 1999

Floor covering consisting of hard floor panels and process for the manufacturing of such floor panels.

This invention relates to a floor covering consisting of hard floor panels, as well as a process for the manufacturing of such floor panels.

In the first place the invention is meant for so-called laminated floors, though in general it can also be applied to other kinds of floor covering, which consist of hard floor panels, such as veneer parquet, ready-to-lay parquet or other floor panels which are comparable to laminated floor.

It is known that such floor panels can be applied in different ways.

According to a first possibility the floor panels are applied to the underlying bottom, either by glueing together or by nailing. This technique has the disadvantage of being rather laborious and that afterwards changes can only be made by breaking away the floor panels.

According to a second possibility the floor panels are laid loosely onto the ground, the floor panels fitting together by means of a tooth and groove coupling, in which mostly also tooth and groove are glued together. The floor obtained in this way, also called floating parquet, has the advantages of being easy to lay and that the entire floor surface is moveable, which is often favourable to overcome possible phenomena of expansion and shrinkage.

A disadvantage of a floor covering of the above mentioned type, especially when the floor panels are laid loosely onto the ground, exists in the fact that when the floor expands and then shrinks back the floor panels themselves can slide apart, which creates unwanted gaps, for example when the glued connections break.

To remedy this disadvantage, techniques were already thought of in which metal connecting elements are applied between the different floor panels to keep them together. Such connecting elements are however quite

expensive to produce and moreover the application thereof, or the installation thereof, is a time-consuming activity.

Examples of constructions which make use of such metal connecting elements are among others described in the documents WO 94/26999 and WO 93/13280.

Besides these, couplings are known which permit the clicking into each other of floor parts, among others from the documents WO 94/01628, WO 96/27719 and WO 96/27721. The click-effect obtained with these types of construction does however not ensure a 100 percent optimal resistance against the formation of gaps between the floor panels, more particularly because in reality certain plays have to be provided to make sure that the clicking into each other is possible.

From the GB 424.057 a coupling for parquet parts is known which, given the nature of the coupling, is exclusively suitable for massive parquet.

More couplings for panels are known from the documents GB 2.117.813, GB 2.256.023 and DE 3.544.845. These couplings are however not suitable for the connecting of floor panels.

The invention aims at an improved floor covering of the afore-mentioned type, of which the floor panels can be coupled together in an optimal way and/or of which the floor panels can easily be manufactured, with the preferable exclusion of one or more of the afore-mentioned disadvantages.

The invention also aims at a floor covering which has the advantage that no faults, such as cracks and the like, can be created in the laying.

The invention further aims at a floor covering in which the formation of cracks is excluded, if not optimally counteracted, also minimising the chance of penetration of dirt or moisture.

To this purpose the invention relates to a floor covering consisting of hard floor panels which are at least at the edges of two opposite sides provided with co-operating coupling parts, mainly in the form of a tooth and a groove, characterised in that the coupling parts are provided with integrated mechanical locking means, which prevent two coupled floor panels from sliding apart in a direction perpendicular to the edges concerned and parallel to the bottom side of the coupled floor panels. For this the coupling parts are optimised in such a way that they permit each form of play to be counteracted and preferably excluded.

With integrated mechanical locking means is meant that these are a fixed part of the floor panels, either because they are in a fixed connection with the floor panels or because they are constructed with them in one piece.

In a first important preferred embodiment the coupling parts are provided with locking means which in coupled state of two or more of such floor panels apply a tension to each other which forces the floor panels towards each other. With this is not only achieved that during the laying the formation of cracks is counteracted, but also that in a later stage the formation of cracks, due to whatever cause, is counteracted.

In addition, according to another feature of the invention the coupling parts are constructed in one piece with the core of the floor panels.

According to a second important preferred embodiment the afore-mentioned optimising exists in the fact that the floor covering shows the following combination of features: that the coupling parts and locking means are constructed in one piece with the core of the floor panels; that the coupling parts have such a shape that two successive floor panels can exclusively be joined together by clicking and/or rotating, in which each next panel can be laterally joined to the former; that the coupling parts provide a play-free locking in all directions in the plane perpendicular to the afore-mentioned edges; that the possible difference between the upper lip and the

lower lip of the lips which delimit the afore-mentioned groove, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove, is smaller than once the total thickness of the floor panel; that the total thickness of each floor panel concerned is larger than or equal to 5 mm; and that the basic material of the floor panels, from which the afore-mentioned core and the locking means are formed, consists of a ground and by means of a binding agent or by fusing into one mass combined product and/or of a product with a base of plastic material and/or of a chipboard with fine chips.

Because of the fact that the coupling parts are provided with a play-free locking, as well as the fact that these coupling parts are constructed in one piece from the basic material of the floor panels, a perfect connection between adjoining floor panels can always be guaranteed, even with repeated expansion and shrinkage of the floor surface.

This combination of features can or cannot be combined with the afore-mentioned feature which says that the coupling means apply a tension to each other.

According to a third important preferred embodiment, of which the features can or cannot be combined with the features of the previously described embodiments, is the floor covering characterised in that the lower lip which delimits the bottom side of the groove extends beyond the upper lip; that the locking means are at least formed by an inwards and downwards pointing part; and that this part is at least partly situated in the part of the lower lip which extends beyond the upper lip. The advantages of these features will appear out from further description.

According to a preferred embodiment the floor panels consist of oblong panels and the previously described coupling parts are provided along the longitudinal sides of these panels.

According to a special embodiment also the other two sides are provided with coupling parts, whether or not of a different construction as described above.

In the most preferable embodiment the afore-mentioned ground and by means of a binding agent into one mass combined product will be used as basic material. More particularly finely ground wood which is preferably glued together, more particularly glued indelibly, will be used for the core. Even more particularly so-called HDF-board (High Density Fireboard) or MDF-board (Medium Density Fireboard) will be used for the core.

The fact that the invention is applied to floor panels whose basic material consists of the previously described material, has the advantage that in the processing of this material very smooth surfaces are obtained, so that very precise couplings can be realised, which is especially important in the case of a play-free click connection and/or turn connection. Also very particular shapes of coupling parts can easily be accomplished, as the afore-mentioned material types can very easily be processed.

The with HDF and MDF obtained surfaces also have the advantage that the floor panels in coupled state can easily be translated alongside each other, even when they are connected with a tension.

The inventor has also noticed that the afore-mentioned materials, particularly HDF and MDF, have ideal properties to realise a connection as described, as these materials have the right properties as to elastic deformation to, on the one hand, realise a click-effect and, on the other hand, cushion expansion and shrinkage forces in an elastic manner, without causing the floor panels to spring apart or to be damaged irrevocably.

In the case of using a material with a base of plastic for the core, both a solid plastic and a mixture of plastic, possibly composed of recycled materials, can be used.

The floor covering is preferably formed by connecting the foor panels in a glue-less manner. Furthermore the connections are of such nature that the floor panels can be separated again without damaging them, so that for example they can be taken along in the case of a move and be replaced. However, it is clear that a glueing together of tooth and groove is not excluded.

The invention of course also relates to floor panels which permit the realisation of the afore-mentioned floor covering.

The invention further relates to a process for the manufacturing of the afore-mentioned floor panels which has the advantage that the teeth and/or grooves, including the locking means which belong to them, without problems can be applied to a high production rate in the floor panels. More particularly it aims at a process which permits the rather complicated shapes of the tooth and the groove of the afore-mentioned floor panels to be completely realised with milling cutters whose diameter can be chosen independently from the shape which has to be realised, so that the use of small cutters, for example end mills, with diameters smaller than the depth of the groove or tooth can be excluded.

To this purpose the process shows the feature that the tooth and/or groove are realised by means of a milling process with at least two successive cutter motions by means of cutters which are set up in different angles in respect to the floor panel concerned. During each of the afore-mentioned cutter motions each time mainly the ultimate shape of one side, of either tooth or groove, is realised.

So, for the afore-mentioned two cutter motions cutters are used which extend beyond the groove, respectively the tooth. More particularly the diameters of these cutters will be at least 5 times and preferably even at least 20 times larger than the thickness of the floor panels.

The use of cutters with the afore-mentioned diameters has the advantage that the normal production rates can be maintained which are also applied for cutting a classic straight tooth and groove. Also the advantage arises that the installation of such cutters involves no or few additional costs, as such cutters can be directly placed on a motor shaft and/or the usual machines can be applied.

In view of a better demonstration of the features of the invention, a few preferred embodiments are described below as an example without any restricting quality. Reference is given to the enclosed drawings, in which:

- figure 1 is a floor panel of a floor covering according to the invention;
- figure 2 shows a larger scale section according to line II-II in figure 1;
- figures 3 and 4 show how two floor panels with coupling parts fit into each other according to figure 2;
- figure 5 shows a larger scale section according to line V-V in figure 1;
- figures 6 and 7 show how two floor panels with coupling parts fit into each other according to figure 5;
- figures 8 to 11 show some other variants of coupling parts of floor panels according to the invention;
- figure 12 schematically shows how the floor parts can be provided with coupling parts;
- figure 13 shows a section according to line XIII-XIII in figure 12;
- figures 14 to 21 on a larger scale and in section show the interference of the cutters which are indicated with the arrows F14 to F21 in figure 12;
- figure 22 shows a floor panel according to the invention;
- figure 23 on a larger scale shows the coupling of two floor panels of figure 22;
- figures 24 and 25 show two ways to join floor panels together according to figure 22.

The invention relates to a floor covering which is composed of hard floor panels 1, for example as depicted in figure 1.

These floor panels 1 can be of a different shape, for example rectangular or square, or of any other shape.

In the most preferred embodiment they will be constructed in an oblong form, as depicted in figure 1, for example with a length from 1 to 2 meters. The thickness can of course also vary, but preferably measures from 0.5 to 1.5 cm, and more particularly 0.8 cm.

Each floor panel 1 is at least at the edges of two opposite sides 2-3 provided with coupling parts 4-5, which permit the coupling together of two adjoining floor panels 1.

According to the invention the coupling parts 4-5, as shown by the figures 2 to 4, are provided with integrated mechanical locking means 6 which prevent two coupled floor panels 1 from sliding apart in a direction D perpendicular to the edges 2-3 concerned and parallel to the bottom side 7 of the coupled floor panels 1; the coupling parts 4-5 and locking means 6 are constructed in one piece with the core 8 of the floor panels 1; the coupling parts 4-5 have such a shape that two successive floor panels 1 can exclusively be joined together by clicking and/or rotating, in which each next panel can be laterally joined to the former; and that the coupling parts 4-5 provide a play-free locking in all directions in the plane perpendicular to the afore-mentioned edges.

In the case of floor panels 1 with an oblong shape, as depicted in figure 1, the coupling parts 4-5 concerned are located on the longitudinal sides 2-3.

The coupling parts 4-5 can be constructed in different forms, although the basic forms of these will always be formed by a tooth 9 and a groove 10.

In the embodiment of figures 2 to 4, the floor panel 1 concerned is provided with coupling parts 4-5 and locking means 6 which permit two floor panels 1 to be joined together by means of a rotation, without the occurrence of any click-effect.

The locking means 6 in the given example consist of a first locking element 11, formed by a protrusion with a curved convex shape at the bottom side 12 of the tooth 9, and a second locking element 13, formed by a recess with a curved concave shape in the lower wall 14 of the groove 10.

The locking elements 11-13 make sure that two connected floor panels 1 cannot perform a sidelong movement in the horizontal plane in relation to each other.

In order to obtain that two floor panels 1 can be slid into each other by means of a rotation, the curves are preferably of a circular shape. The bottom side 12 shows a curvature with radius R1 the centre of which coincides with the corresponding top edge 15 of the floor panel 1, whereas the lower wall 14 shows a curvature with radius R2, equal to R1, but the centre of which coincides with the corresponding top edge 16. Also radii R1 and R2 can be applied which are larger or smaller than the distance to the top edge 15, respectively 16 and/or which mutually differ in size.

The top side 17 of the tooth 9 and the upper wall 18 of the groove 10 are preferably flat and are situated in the horizontal plane.

The sides on end 19 and 20 of the tooth 9 and the groove 10 of two connected floor panels do preferably not link up, so that a space 21 is formed in between into which possible dust remains or the like can be pressed away by the tooth 9.

The tooth 9 and the groove 10 preferably have complementary shapes, so that the tooth 9 in the coupled state of two floor panels 1 links up precisely to the upper wall 18 and the lower wall 14 of the groove 10, as a result of which a pressure P is exerted on the upper lip 22, cushioned not only

by this lip 22, but by the whole structure, as this pressure can propagate through the tooth 9 and the lower lip 23.

It is clear that a number of small deviations from these complementary shapes can occur which have however no or little influence on the cushioning and transferring of pressure forces. Like this, for example a bevel 24 and a recess 25 can be provided, as depicted in the figures 2 to 4, by which is obtained that the successive floor panels 1 can easily be slid into each other, without possible burrs or the like hampering the good connection.

As shown in the figures 5 to 7 the floor panels 1 according to the invention can also be provided with coupling parts 28-29, which also show locking means 30, along the sides 26-27 which are perpendicular to the sides 2-3. The coupling parts 28-29 are preferably also constructed in the form of a tooth 31 and a groove 32. The locking means 30 here do not have to be of the same nature as the locking means 6.

Preferably, on the sides 26-27 locking means are used which permit a joining and locking only by a translation T as depicted in the figures 6 and 7. The locking elements 30 for this purpose consist of a click connection with locking elements 33 and 34 which engage behind each other.

As depicted in the figures 5 to 7 the locking element 33 preferably consists of a protrusion on the bottom side 35 of the tooth 31 which can take place in a recess 36 in the lower wall 37 of the groove 32. The locking element 34 is formed by the upright part which delimits the recess 36.

The locking elements 33-34 in this case have contact planes 38-39 which are parallel to each other and preferably extend slanting, in a direction which facilitates the clicking together. Therefore the tangent line L which is determined by the contact planes 38-39 makes an angle A with the bottom side 7 which is smaller than 90°.

The locking elements 33-34 are preferably provided with bevels 40 and 41 which co-operate in the joining of two floor panels 1 so that the locking means 33-34 can easily be pushed over each other until they engage behind each other by means of a click-effect.

The thickness W1 of the tooth 31 with the width W of the groove 32, so that the upper lip 42 upon exerting a pressure P is supported by the tooth 31, which is in its turn supported by the lower lip 43.

Analogous to the bevel 24 and the recess 25, also on the edges 28-29 a recess 44 and a bevel 45 are provided.

It is noted that such a click connection can also be applied to the edges 2-3. This can be a click connection analogous to the one of the figures 5 to 7, but this can also be a click connection in which other forms of coupling parts are used, for example as shown in the figures 8 and 9. Contrary to the locking elements 33-34, which consist of rather local protrusions, in the embodiments of the figures 8 and 9 use is made of locking elements 46-47 which extend over a fairly large distance in comparison with the total width B of the coupling.

The locking elements 46-47 are in this case also provided on the bottom side 12 of the tooth 9 and the lower wall 14 of the groove 10.

According to figure 8 the locking elements 46-47 show contact planes 48-49 which are perpendicular to the plane of the floor panel 1. This leads to a very firm coupling.

As shown in figure 9 the locking elements 46-47 can possibly constructed in such a way that mainly only a line contact is formed, for example by constructing the contact planes which face each other with different curvatures.

For this purpose the laterally facing planes of the locking elements 46-47 consist of curved planes. The tangent line L makes an angle A which is smaller than 90°, and preferably even smaller than 70°.

The locking element 46 preferably has two parts with a different curvature, on the one hand a part 50 with a steep slope and, on the other hand, a part 51 with a weak slope. The part 50 with the steep slope makes sure that a firm coupling is formed. The part 51 with the weak slope permits the coupling parts 4-5 to be joined easily. The space S forms a space which gives room to dust and the like which possibly ends up there when two floor panels 1 are joined together.

In the case of a click connection, for example a connection as shown in the figures 7 to 9, the tooth 9-31 preferably shows a downwardly thickening shape which can co-operate with a widening in the groove 10.

In figure 10 a variant is shown in which at least at the location of the top edges 15-16 a sealing material 52 is provided, by which a waterproof sealing can be ensured. This sealant 52 can consist of a strip or covering which is provided beforehand on the floor panel 1, or on one or both top edges 15-16.

In figure 11 another variant is shown, in which the locking means 6 are formed by an upright part 53 on the tooth 9, which ends up behind a downwards pointing part 54 and is part of the upper wall 18. More particularly this is realised by constructing the top side 17 and the upper wall 18 with a curvature R3 of which the centre is located on the edges 15-16 and constructing the bottom side 12 and the lower wall 14 with a radius R4 of which the centre is also located on respectively the edges 15 and 16. These radii R3-R4 can also be chosen in a different manner.

In general, according to the invention the difference between on the one hand the radius R1, respectively R3, and on the other hand the radius R2, respectively R4, will preferably not be larger than 2 mm.

It is also preferred that the centre of these radii is located inside the circle C1, respectively C2, which extends itself with a radius of 3 mm around the top edge 15, respectively 16, as for example depicted in figure 2.

Finally it is noted that, according to the invention the lower lip 23-24 as shown in the figures 2 to 7 can be constructed longer than the upper lip 22-42. This has the advantage that the coupling parts 4-5-28-29 can be realised more easily by means of a cutter or the like. Furthermore this facilitates the joining together of two floor panels 1, as each next floor panel 1 in the attaching can be laid onto the protruding lower lip 23-43, by which the tooth 9-31 and the groove 10-32 are automatically positioned opposite each other.

The constructions in which the lower lip 23 is equal to, or shorter than, the upper lip 22 then again have the advantage that on the utmost edge of the floor no protruding lip 23 remains which can cause trouble in the finishing.

To permit a swift assembly, to ensure the necessary stability and solidity and to keep the amount of material which has to be cut out limited, the difference E between the upper lip 22-42 and the lower lip 23-43, measured in the plane of the floor panel and perpendicular to the longitudinal direction of the groove 10, will preferably be held smaller than once the total thickness F of the floor panel 1. This total thickness F will normally never be smaller than 5 mm for reasons of stability.

The small size of the difference E has the advantage that the lower lip does not have to be reinforced by a strengthening strip.

According to a special embodiment the axial line M1 through the tooth 9 and the groove 10 is located below the middle M2 of the floor panel 1, so that the upper lip 22-42 is thicker than the lower lip 23-43. This is mainly important with this type of connections, because then the lower lip 23-43 bends, so that the top side of the floor panel 1 remains free of possible deformations.

As is explained in the introduction, for the core 8 a material is chosen from the following list:

- a ground and by means of a binding agent or by fusing into one mass combined product;
- a product with a base of a plastic material;
- a chipboard with fine chips.

The invention proves, because of the in the introduction explained reasons, especially its use with laminated parquet.

As given by the examples of the figures 2 to 11 such laminated parquet preferably consists of a core 8 from MDF-board, HDF-board or the like, on the top side of which at least one or more material layers are provided.

More particularly it is preferred that the laminated parquet is provided with a design layer 55 and a protecting top layer 56. The design layer is a layer impregnated with resin, for example from paper, which can be printed in all sorts of patterns, such as a wood pattern, a patters in the shape of stone, cork or the like or even in a fancy pattern. The protecting top layer 56 preferably also consists of a layer from a transparent material, saturated with resin, for example melamine resin.

It is clear that other layers can be applied, such as an intermediate layer 57 onto which the design layer 55 is applied.

Preferably also a bottom layer 58 will be applied to the bottom side 7 which forms a counterweight to the top layers and as such ensures the form stability of the floor panel 1. This bottom layer can consist of a with resin, for example a melamine resin, impregnated material, for example paper.

As shown schematically in figure 12 the tooth 9 and the groove 10, and preferably also the tooth 31 and the groove 32, are provided by means of a milling process. In the case that on all four sides a profile needs to be provided, the floor panels 1 will preferably be moved according to two motions V1 and V2 in right angle, during one of which profiles are provided at two opposite edges, in this case the longitudinal edges, by means of

milling machines 59-60, while during the other motion profiles are provided at the other edges, in this case the edges on end, by means of milling machines 61-62. During these treatments the floor panels 1 preferably lie with the design layer face downwards.

According to an important feature of the invention each tooth 9-31 and groove 10-32 concerned is realised by means of a milling process with at least two cutter motions by means of cutters which are set up in different angles in respect to the floor panel 1 concerned.

This is clarified in the figures 13, 14 and 15, by which is shown how a groove 10 is realised by means of two cutter motions with the help of two cutters 63 and 64. Figures 16 and 17 show how the tooth 9 is realised by means of cutters 65 and 66.

The figures 18-19 and 20-21 show similar views, which show how the groove 32 and the tooth 31 are realised with cutters 67-68 and 69-70 which are set up in angles.

During each of the afore-mentioned cutter motions each time mainly the ultimate shape of one side is realised. Like this, for example the cutter 63 of figure 14 determines the ultimate shape of the lower side 71 of the groove 10, whereas the cutter 64 determines the ultimate shape of the upper side 72.

As mentioned in the introduction preferably cutters 63 to 72 will be used which have diameters G which are at least 5, and better still 20 times larger than the thickness F of the floor panels 1.

Besides the mentioned cutters preferably also other cutters are used, for example during a first pre-treatment to already remove part of the material which has to be removed.

In the figures 22 to 25 a particularly preferred embodiment of a floor panel 1 according to the invention is shown. The parts of this which have

been copied from the previous embodiments are indicated with corresponding references.

An important feature thereof resides in the fact that the coupling parts 4-5 are provided with locking means 6 which in coupled state apply a tension to each other which forces the floor panels 1 towards each other. As indicated this is preferably realised by providing the coupling parts with an elastic bendable part, in this case the lip 43, which in coupled state is at least partly bent and thus produces a tension which makes sure that the coupled floor panels 1 are forced towards each other. The bending V which occurs here, as well as the tension K resulting from this are indicated in the enlargement of figure 23.

The bendable part, in this case the lip 43, is, in order to obtain that the tension K results in a closing of the coupled floor panels 1, as shown, preferably provided with a contact plane (73) which is pointed towards the inside and slanting towards the bottom and preferably can co-operate with a corresponding contact plane 74. These contact planes 73-74 are comparable to the afore-mentioned contact planes 39-38, and also comparable to the slanting parts in the lower lip of figures 2 to 4.

In the figures 2 and 5 these parts show complementary fitting shapes, but it is clear that provided an adaptation is made also a tension as in figure 23 can be realised.

Because of on the one hand the contact at the angle A, and on the other hand the fact that a tension K is created, a force component K1 is created which forces the floor panels 1 towards each other.

Preferably the angle A of the contact planes 73-74 in respect to the horizontal plane measures between 30 and 70°.

Especially in the case when use is made of the construction in which a tension K is realised an angle A from 30 to 70 degrees is ideal, on the one hand to obtain an optimal closing of the floor panels 1, and on the other hand

to obtain that the floor panels 1 can easily be joined together, respectively be separated again.

Although the closing force K1 is preferably produced by the aforementioned lip 43, the invention does not exclude other embodiments in which this force is produced by other bendable parts.

It is noted that the bending V is relatively small, for example a few hundredths to a few tenths of a millimetre, and has no influence on the location of the floor covering. Furthermore is noted that such floor covering is generally laid on a ground layer which is elastically compressible, so that the bending V of the lip only results in the fact that the ground layer is locally compressed somewhat more.

By the fact that the lip 43 is bent outwards, and in coupled state remains a little bent, the advantage also arises that when a pressure is exerted onto the floor covering, for example when an object is placed on top, the closing force is enlarged and so the formation of cracks is even more counteracted.

It is noted that the inventor has found that, contrary to all expectations, an ideal tension can be realised by manufacturing the coupling parts 4-5, including the locking elements 33-34, and preferably the entire core 8, from HDF-board or MDF-board, although those materials permit only a slight elastic deformation.

HDF and MDF also have the advantage that smooth surfaces are achieved, so that the locking elements can be easily moved over each other.

According to a variant of the invention the tension can also be produced by an elastic compression of the material of the coupling parts, for which these coupling parts, and preferably the whole core 8, however do have to consist made out of an elastic compressible material.

Another special feature of the construction of figures 22 to 25 exists in the fact that the floor panels 1 can be joined together both by means

of a rotation, as depicted in figure 24, and by means of a translation towards each other, as depicted in figure 25, one thing and another preferably as such that in the case of the joining together by means of a rotation a maximal bending Vm in the coupling parts, more particularly in the lip 43, occurs which is less distinct, if not non-existent, in comparison with the bending Vm which occurs when the floor panels 1 are joined together by means of a translation towards each other.

The advantage of this exists in the fact that the floor panels 1 can easily be joined together by means of a rotation, without a tool being necessary for this purpose, but that it still remains possible to join the floor panels 1 together by means of a translation. The latter is especially useful when the final panel needs to be laid partly underneath a doorcase or the like. In that case the floor panel 1 can first be slid underneath the doorcase with the side which does not have to be coupled and then, possibly with the help of a tool, clicked into the adjoining floor panel.

It is noted that the shapes of the coupling parts 4-5 shown by figures 22 to 25, can also be applied to the coupling parts 28-29 of the short sides.

According to the invention, in the case that the four sides 2-3-26-27 are provided with coupling parts 4-5-28-29, these coupling parts can be constructed in such a way that a firmer engagement exists in one direction than in the other direction. In the case of the oblong floor panels 1, for example as depicted in figure 1, the engagement on the sides on end 26-27 will preferably be more distinct than that on the longitudinal sides 2-3. The length of the coupling on the short sides is after all smaller and principally lees firm. By providing a more distinct engagement, this is compensated.

This difference in engagement can be obtained by realising the contact planes 73-74 at different angles.

Preferably the afore-mentioned protrusion, more particularly the locking element 33, is delimited by at least two parts 75-76, respectively a part 75 with a steep slope which takes care of the locking, and a part 76 with a more weak slope, which facilitates the joining together of the coupling parts. In the construction of figures 22 to 25 these parts are formed by flat planes, although use can also be made of curved parts 50-51 as has already been described by means of figure 9. In figure 5 these are the contact plane 38 and the bevel 40.

In the preferred embodiment the floor panels 1 according to the invention have coupling parts 4-5 and/or 28-29 which show one of the following or the combination of two or more of the following features:

- a slope 77 on the bottom side of the tooth 9 and/or a slope 70 on the lip 43 which form a guiding for the rotating into each other of two floor panels 1, with the advantage that the floor panels 1 in the laying can easily be joined together;
- roundings 79-80 on the edges of the locking elements 33-34, with the advantages that the locking elements can easily slide over each other in the joining, respectively separating of the floor panels 1 and that the locking elements are not damaged, for example crumble on their edges, even when the floor panels are repeatedly joined together, respectively separated;
- dust chambers 81, or spaces 21 as in figure 4, between all the laterally facing sides of the coupled floor panels 1, with the advantage that enclosed parts which in the joining end up between the floor panels 1 do not have a negative influence on the good connection;
- a shaping of the tooth 9 which is such, for example because of the presence of a bevel 82, that the top side of the tooth 9 will slide under the bottom side of the upper lip 42 already at first contact when the floor panels 1 are slid towards each other on a same level, as indicated on

figure 25, with the advantage that the foremost end of the tooth 9 does not push against the front side of the upper lip 42 when the floor panels 1 are slid towards each other on a same level;

- an ascending plane 83 formed at the free end of the lower lip 43, before also called bevel 41, with the advantage that the locking elements 33-34 easily slide over each other and that the lower lip 43 is bent evenly;
- only one substantial contact point in the direction of compression which is formed by an area 84 at the location of the top side of the floor panels 1, with the advantage that the afore-mentioned tension is transferred to the top side of the floor panels 1 and that the formation of openings between the floor panels 1 is counteracted;
- contact planes 85-86, more particularly stop planes, formed by the top side of the tooth 9 and the top side of the groove 10 which over the major part of their length run parallel to the plane determined by the floor panels 1, with the advantage that no mutual removal in height is possible among two coupled floor panels 1, even when the penetration depth of the tooth 9 into the groove 10 should vary for whatever reason, in other words that no differences in height can occur among the adjoining floor panels.

In the embodiment of figures 22 to 25 all these features are combined, though it is clear that, as appears from the figures 2 to 11, these features can also occur independently or in a limited combination.

As appears from the drawings of the figures 5 to 7 and 22 to 25, an important feature of the preferred embodiment of the invention exists in the fact that the locking elements 6, in other words the part which takes care of the click-effect and the engagement effect, are situated in that part of the lower lip 23-43 which extends beyond the upper lip 22-42, more particularly that the deepest point 87 of the locking element 33 is located below the top layer of the floor panel 1. For clarity's sake this top layer is indicated as a single layer in figures 22 to 25.

It is noted that the combination of features that the lower lip 23-24 extends beyond the upper lip 22-42, that the locking means 6 are at least formed by an inwards and downwards pointing part, whether curved or not, more particularly with a contact plane 39 or 73, and that this part is at least partly situated in the part of the lower lip 23-43 which extends beyond the upper lip 22-42, is particularly advantageous, among others in comparison with the couplings for floor panels which are described in the documents WO 94/01628, WO 94/26999, WO 96/27719 and WO 96/27721. The slanting part has the advantage that the floor panels 1 can after all be separated again. The fact that this slanting part is located in the further extending part of the lower lip 23-43 has the advantage that in the coupling no deformations can occur which manifest themselves up to the top layer.

According to a preferred feature of the invention the afore-mentioned part, in other words the contact plane 39 or 73, preferably is shaped in such a way that from bottom to top the distance to the top edge 16 diminishes, in other words in such a way that as depicted in figure 22 the distance X2 is smaller than the distance X1. This is also the case in figure 7.

Preferably this part also starts on a clear distance E1 of the upper lip 42.

It is clear that the coupling parts of figures 22 to 25 can also be realised by means of the afore-mentioned milling process.

According to a special feature of the invention the floor panels 1 are on their sides 2-3 and/or 26-27 treated with a surface condenser, which is preferably chosen from the following range of products: impregnation means, pore fillers, varnishes, oils, paraffin waxes and the like.

In figure 22 such an impregnation 88 is shown schematically. This treatment can be executed over the total surface of the sides 2-3 and/or 26-27 or only over certain parts of them, for example only the surfaces of the tooth 9 and the groove 10.

The treatment with such a surface condenser, in combination with the click-effect, has the advantage that in many ways better coupling features are obtained. The coupling parts 4-5 and/or 28-29 because of this better retain their shapes and strengths, even when the fps 1 are repeatedly joined together and separated. Especially in the case that for the core 8 use is made of HDF, MDF or the like a qualitatively so much better surface state is achieved by means of this treatment that no scraping of material occurs in the joining, respectively separating.

This treatment also has the advantage that, surely in the case of a surface hardening, the afore-mentioned elastic tensile effect is improved.

Today's invention is by no means limited to the embodiments described in the examples and shown by the figures, though such floor covering and the accompanying floor panels 1 can be realised in different shapes and sizes without exceeding the scope of the invention.

Like this, for example the different features which are described by means of the given embodiments can or cannot be mutually combined.

Also all the forms of coupling parts described above can be applied to both the long and the short sides.

Claims

1. Floor covering, consisting of hard floor panels (1) which are at least at the edges of two opposite sides (2-3, 26-27) provided with co-operating coupling parts (4-5, 28-29), mainly in the form of a tooth (9-31) and a groove (10-32), characterised in that the coupling parts (4-5, 26-27) are provided with integrated mechanical locking means (6) which prevent two coupled floor panels from sliding apart in a direction (R) perpendicular to the edges concerned (2-3, 26-27) and parallel to the bottom side (7) of the coupled floor panels (1).

2. Floor covering according to claim 1, characterised in that the coupling parts (4-5, 28-29) are provided with means, which are more particularly formed by the afore-mentioned locking means (6), which in coupled state of two or more of such floor panels (1) apply a tension to each other which forces the floor panels (1) towards each other.

3. Floor covering according to claim 2, characterised in that at least one of the coupling parts (5) shows an elastic bendable part, which in coupled state is at least partly bent and thus produces the afore-mentioned tension.

4. Floor covering according to claim 3, characterised in that the elastic bendable part consists of one lip, preferably the lip (43) which delimits the bottom side of the afore-mentioned groove (10).

5. Floor covering according to claim 3 or 4, characterised in that the bendable part is provided with a contact plane (39-73) which is pointed towards the inside and slanting towards the bottom.

6. Floor covering according to one of the preceding claims, characterised in that the coupling parts (4-5, 28-29) and the locking means (6) are constructed in one piece with the core (8) of the floor panels (1).

7. Floor covering according to one of the preceding claims, characterised in that the floor covering further shows the following

combination of features: that the coupling parts (4-5, 28-29) and locking means (6) are constructed in one piece with the core (8) of the floor panels (1); that the coupling parts (4-5, 28-29) have such a shape that two successive floor panels (1) can exclusively be joined together by clicking or rotating, in which each next panel can be laterally joined to the former; that the coupling parts (4-5, 28-29) provide a play-free locking in all directions in the plane perpendicular to the afore-mentioned edges; that the possible difference (E) between the upper lip and the lower lip of the lips (22-23, 42-43) which delimit the afore-mentioned groove (10, 32), measured in the plane of the floor panel (1) and perpendicular to the longitudinal direction of the groove (10, 32), is smaller than once the total thickness (F) of the floor panel (1); that the total thickness (F) of each floor panel concerned (1) is larger than or equal to 5 mm; and that the basic material of the floor panels (1), from which the afore-mentioned core (8) and the locking means (6) are formed, consists of a ground and by means of a binding agent or by fusing into one mass combined product and/or of a product with a base of plastic material and/or of a chipboard with fine chips.

8. Floor covering according to one of the preceding claims, characterised in that the basic material of the floor panels (1), in other words the material of the core (8), consists of HDF-board or MDF-board, from which the coupling parts (4-5, 28-29) and the locking means (6) are formed.

9. Floor covering according to one of the preceding claims, characterised in that the floor panels (1) consist of oblong panels and that they are at least on their longitudinal sides (2-3) provided with the afore-mentioned coupling parts (4-5, 28-29).

10. Floor covering according to one of the claims 1 to 8, characterised in that the floor panels (1) are rectangular or square and that they are on all four sides (2-3-26-27), more particularly two by two, provided with the afore-mentioned coupling parts (4-5, 28-29).

11. Floor covering according to one of the preceding claims, characterised in that the coupling parts (4-5 and/or 28-29) of at least two opposite sides (2-3, 26-27) are constructed in such a way that the floor panels (1) can be joined together by means of a translation towards each other as well as by means of a rotation, and that in the case of the joining together by means of a rotation a bending of the coupling parts (4-5 and/or 28-29) occurs which is less distinct, if not non-existent, in comparison with the bending which occurs when the floor panels (1) are joined together by means of a translation towards each other.

12. Floor covering according to one of the preceding claims, characterised in that the locking means (6) mainly consist of a locking element (11-33-46) in the form of a protrusion which is provided at the bottom side of the tooth (9, 31) and a locking element (13-34-47) formed in the lip which delimits the bottom side of the groove (10); more particularly in the lower wall (14) of the groove (10, 32); the locking element (13-34-47) having the form of a recess (36) and/or an upright part which is delimited by this recess (36).

13. Floor covering according to claim 12, characterised in that the bottom side of the afore-mentioned protrusion is delimited by at least two parts (50-51, 75-76), respectively a part (50-75) with a steep slope which takes care of the locking, and a part (51-76) with a more weak slope which facilitates the joining of the coupling parts (4-5).

14. Floor covering according to one of the preceding claims, characterised in that the coupling parts (4-5, 28-29) are provided with locking elements (33-34-46-47) which permit a click connection.

15. Floor covering according to claim 14 or 15, characterised in that the locking means (6) are provided with locking elements (33-34-46-47) which are constructed in such a way that the tangent line (L) which is

determined by their contact planes makes an angle (A) with the bottom side (7) of the floor panels, which measures 30 to 70°.

16. Floor covering according to one of the preceding claims, characterised in that the coupling parts (4-5, 28-29) are constructed in the form of a tooth (9-31) and a groove (10-32) and that the lip (23-24) which delimits the bottom side of the groove (11-32) extends beyond the lip (22-42) which delimits the top side of the groove (10-32).

17. Floor covering according to claim 16, characterised in that the locking means (6) are among others formed by locking elements (34) which are situated in the part of the lower lip (23-43) which extends beyond the upper lip (22-42), more particularly that the deepest point (87) of engagement of the locking elements (34) is located below the top layer of the floor panel (1) which carries the tooth (9) concerned.

18. Floor covering according to claim 16 or 17, characterised in that the coupling parts (4-5) show one of the following or the combination of two or more of the following features:

- a slope (77) on the bottom side of the tooth (9) and/or a slope (70) on the lip (43) which form a guiding for the rotating into each other of two floor panels (1);
- roundings (79-80) on the edges of the locking elements (33-34);
- dust chambers or the like (21-44-81) between all the laterally facing sides of the coupled floor panels (1);
- a shaping of the tooth (9) which is such that the top side of the tooth (9) will slide under the bottom side of the upper lip (42) already at first contact when the floor panels (1) are slid towards each other on a same level;
- an ascending plane (41-83) formed at the free end of the lower lip (43);
- only one substantial contact point in the direction of compression which is formed by an area (84) at the location of the top side of the floor panels (1);

– contact planes (85-86), more particularly stop planes, formed by the top side of the tooth (9) and the top side of the groove (10) which over the major part of their length run parallel to the plane determined by the floor panels (1).

19. Floor covering according to one of the preceding claims, characterised in that the lower lip (23-43) which delimits the bottom side of the groove (10) extends beyond the upper lip (22-42); that the locking means (6) are at least formed by an inwards and downwards pointing part; and that this part is at least partly situated in the part of the lower lip (23-43) which extends beyond the upper lip.

20. Floor covering according to claim 19, characterised in that the afore-mentioned part (39-73) has such a profile that from the bottom towards the top the distance (X1-X2) to the top edge of the floor panel (1) diminishes.

21. Floor covering according to one of the preceding claims, characterised in that the floor panels (1) are constructed as laminated parquet; one or more layers, among which a design layer (55), being applied onto the core (8) and a bottom layer (58) being provided on the bottom side (7).

22. Floor covering according to one of the preceding claims, characterised in that the coupling parts are treated at their surface, in other words the sides of the floor panels (1), with a surface condenser, more particularly a surface hardening agent.

23. Floor covering according to one of the preceding claims, characterised in that the floor panels (1) are connected to each other in a glue-less manner, so that they can be separated and re-used.

24. Floor panel for the realisation of a floor covering according to one of the claims 1 to 23.

25. Process for the manufacturing of floor panels as described in one of the preceding claims, characterised in that the tooth (9-31) and/or the

groove (10-32) are realised by means of a milling process with at least two successive cutter motions by means of cutters (63-64-65-66-67-68-69-70) which are set up in different angles in respect to the floor panel (1) concerned.

26. Process according to claim 25, characterised in that during each of the afore-mentioned cutter motions each time mainly the ultimate shape of one side (71-72), of either tooth or groove, is realised.

27. Process according to claim 25 or 26, characterised in that for the two afore-mentioned cutter motions cutters (63-64-65-66-67-68-69-70) are applied which extend beyond the groove (10-32), respectively tooth (9-31), and more particularly also have diameters (G) which are at least 5 times larger than the thickness (F) of the floor panels (1), and preferably even at least 20 times larger than the thickness (F) of the floor panels (1).

28. Process according to one of the claims 25 to 27, characterised in that on all four sides of the floor panel (1) a profile is provided, and that the floor panels (1) are moved according to two motions (V1-V2) at right angles, during one of which profiles are provided at two opposite edges, while during the other motion profiles are provided at the edges on end.